Fact Sheet

Aquifer Protection Permit P-106019
Place ID 509495-00, LTF 47849
Temporary Individual Permit
APS – Cholla Power Plant
(Carbon Sequestration Pilot Test)

The Arizona Department of Environmental Quality (ADEQ) proposes to issue a Temporary Aquifer Protection Permit for the subject facility that covers the life of the facility, including operational, closure, and post-closure periods, unless suspended or revoked pursuant to Arizona Administrative Code (A.A.C.) R18-9-A213. This temporary permit expires 1 year from the date of issuance and is eligible for renewal once. This document gives pertinent information concerning the issuance of the permit. The requirements contained in this permit will allow the permittee to comply with the two key requirements of the Aquifer Protection Program (1) meet Aquifer Water Quality Standards (AWQS) at the Point of Compliance (POC), and (2) demonstrate Best Available Demonstrated Control Technology (BADCT). BADCT's purpose is to employ engineering controls, processes, operating methods or other alternatives, including site-specific characteristics (i.e., the local subsurface geology), to protect drinking water aquifers from pollutants.

I. FACILITY INFORMATION

Name and Location

Permittee's Name:	APS – Cholla Power Plant
Mailing Address:	P.O. Box 188, MS 7668 Joseph City, Arizona 86032
Facility Name and Location:	APS – Cholla Power Plant (Carbon Sequestration Pilot Test) 4801 Frontage Road Joseph City, Arizona 86032

Regulatory Status

Although the location of this permitted facility is on the site currently operating under an existing current permit, this is a new permit. The work performed under this permit is for a pilot test, and is not planned to last longer than a few months. Therefore, there is no regulatory status associated with this permit.

Facility Description

This permit allows for the installation of an injection well for the purpose of conducting a pilot test to inject approximately 2,000 tons of food-grade, supercritical carbon dioxide into the Martin Formation. The injection will occur at approximately 4,000 feet below ground surface. The overall goal of the pilot test is to gain practical experience with, and demonstrate the potential for, safe carbon dioxide storage in

deep underground geologic formations in a location with large, surface carbon dioxide sources, such as the Cholla Power Plant, and large subsurface carbon dioxide storage potential. This injection test will incorporate food-grade, supercritical carbon dioxide to ascertain the maximum injection pressure and flow rate achievable, without causing fracturing in the geologic formation.

Closure Description

Upon completion of the pilot test, the injection well shall be plugged and abandoned in accordance with rules adopted by the Arizona Oil and Gas Conservation Commission.

II. BEST AVAILABLE DEMONSTRATED CONTROL TECHNOLOGY

Typical BADCT practices for aquifer protection cannot necessarily be implemented here, as BADCT applies to the quality of the media added to the aquifer through various pollution removal technologies and the quality of the discharged media will be food-grade. Instead, physical parameter monitoring shall be adopted to ensure safe practices and BADCT during operational periods, in addition to pre- and post-injection water quality sampling of the injection aquifer and shallower aquifer. The overall goals of the applied BADCT are to (1) protect the formation from fracturing, and (2) protect the shallower drinking water aquifers from exposure to the injected carbon dioxide. This pilot project is in essence a test that will provide information that may be relevant to potential future commercial scale carbon dioxide injection and sequestration projects.

The BADCT shall follow conservative, established procedures that minimize the risk of carbon dioxide leakage into shallow aquifers and fracturing of the target injection zone, the Jerome Member of the Martin Formation (with the shallower Naco Formation as the backup). Other possible outcomes of carbon dioxide injection include displacement of native fluids and chemical constituents, and potential leaching and mobilization of naturally occurring metals and minerals within the confining formation. Geological impacts to the nearby aquifer shall be considered with respect to site location, and shall be guarded against by the application of BADCT.

The BADCT shall be applied through well siting, construction, operation, and closure of the injection well, with the inclusion of monitoring parameters during the step-rate injection test (SRT), well integrity monitoring practices, and monitoring of carbon dioxide movement within the aquifer. Each of these methods is described in detail below.

Monitoring Step Test Parameters – The SRT, as it applies to BADCT, is the measured control of the injection flow rate and monitoring of the associated pressure for the duration of the pilot test. The step test shall begin at a lower flow rate and increase in equal intervals (at least five steps shall be planned) with continuous monitoring of associated pressures, until a slight pressure drop is observed. This first

pressure drop typically indicates fracture pressure, which is the amount of pressure required to initiate flow of formation water into the injection zone. This pressure is slightly higher than the required operational pressure for continued injection, due to the initial force required for the formation water injected to overcome, or displace, the head and capillary fringe that hold air and/or liquid within the formation pores and/or fractures.

This methodology guards against fracturing of the formation due to the step-controlled increase of the flow rate, which allows for some control over the associated pressure. A measured pressure drop of more than 10 percent at any point during the test will indicate a failure, which is a fracture of the formation, and contingency actions shall be implemented as described in the permit.

This step-rate test will aide in establishing the target flow rate and injection pressures for the carbon dioxide pilot test. The absolute maximum injection pressure during carbon dioxide injection at the injection formation shall not exceed 80 percent of the measured or estimated formation fracture (or parting) pressure at that depth. The permit includes the engineering design calculations and associated pressures for the step test.

The injection depth shall be selected based upon well logging results and formation testing. The target injection depth shall fall between the range of 3,600 to 4,500 ft bgs, due to the top of the Jerome Member of the Devonian Martin Formation estimated at approximately 3,600 ft bgs.

Carbon Dioxide Injection Test - The maximum flow rate for the carbon dioxide test shall be determined by the maximum allowable injection pressure as determined by the step-rate injection test using filtered formation water. An inline heater shall provide temperature regulation of the carbon dioxide and maintain the temperature between 40 and 70 degrees Fahrenheit.

Additionally, the injection well annulus pressurization and monitoring system shall maintain a positive pressure versus the tubing pressure for leak detection. Pressurization of the annulus shall be performed using high-pressure nitrogen. Alternatively, a small-volume, high-pressure pump connected to a low-pressure annulus fluid reserve tank may be used to maintain positive annulus pressure on the injection well. These parameters shall be monitored and recorded continuously.

Monitoring Carbon Dioxide Movement – Tracking the movement of carbon dioxide within the formation is critical for the purposes of the aquifer protection and permitting program. A representative sample of the target injection aquifer shall be collected prior to injection of carbon dioxide into the formation to reflect ambient conditions at the point of injection. In addition to sample collection, a vertical seismic profile (VSP) shall be performed to further characterize the carbon dioxide reservoir horizon and the adjunct formations.

III. COMPLIANCE WITH AQUIFER WATER QUALITY STANDARDS

Monitoring and Reporting Requirements

Discharge Monitoring
Discharge monitoring for selected parameters is required under the permit. Discharge monitoring is associated with flow rate, pressure, temperature, and volume with respect to the injection of formation fluid and food-grade carbon dioxide. The location of the injection well is as follows:

Facility	Latitude	Longitude
Injection Well	34º 55’ 43” N	110º 15’ 31” W

Ambient Groundwater Monitoring
Ambient groundwater monitoring shall be conducted in the injection well and in a monitoring well (W-125), which is located in the shallow drinking water aquifer (Coconino aquifer) between the injection well and nearest user of the drinking water aquifer. Ambient groundwater monitoring shall be performed before carbon dioxide injection to establish background water quality in the injection aquifer and shallower drinking water aquifer. Well W-125 is located as follows:

Monitoring Location	Latitude	Longitude
W-125 Located 1,800 feet cross-gradient of Injection Well (depth of 140 ft)	34º 55’ 43” N	110º 16’ 00” W

Operational Groundwater Monitoring
Operational groundwater monitoring shall be performed following the carbon dioxide injection test to compare water quality in the injection aquifer and shallower drinking water aquifer to that of ambient conditions. Operational monitoring includes the collection of water quality samples. One sample will be collected from the injection well and the other from the shallower aquifer monitoring well W-125.

As part of the final report, a discussion of pre- and post-test conditions in both aquifers shall be presented. All monitoring required in this permit shall continue for the duration of the permit, regardless of the status of the facility.

Point(s) of Compliance

POC Location	Latitude	Longitude
Located 400 feet southwest of Injection Well	34º 55’ 40” N	110º 15’ 34” W

ADEQ may require installation and monitoring of the POC, if necessary, based upon the water quality results and/or the evaluation of test data.

IV. STORM WATER AND SURFACE WATER CONSIDERATIONS

Not applicable under this permit as there is no surface discharge and the injection well is isolated from any exposure to storm water runoff. The facility is located outside the 100-year flood plain of the Little Colorado River.

V. COMPLIANCE SCHEDULE

For each compliance schedule item listed below, the permittee shall submit the required information, including a cover letter that lists the compliance schedule items, to the Groundwater Section. A copy of the cover letter must also be submitted to the Water Quality Compliance Section.

Description	Due by
The permittee shall submit a well construction diagram, lithologic log and geophysical logs that confirm the well is constructed according to the Department-approved design report or plans and specifications, as applicable. Lithologic logging shall include 10-foot samples from 40 feet below ground surface to total injection well depth (samples to be provided to OGCC), and deviation survey information from every 500 feet of drilling.	Within 90 days of completion of construction
The permittee shall collect Coconino aquifer water samples from Monitoring Well W-125 and the injection well (during drilling). In addition, a sample of injection zone water shall be collected from the injection well (upon drilling completion) prior to any injection activities and report the results to the Department (Section 4.1, Tables I-B and I-C).	Within 30 days of receipt of the final laboratory report
The permittee shall collect a sample of injection zone water from the injection well at least 1 month following injection activities and report the results to the Department (Section 4.2, Table II-B).	Within 30 days of receipt of the final laboratory report

The permittee shall collect a Coconino aquifer water sample from Monitoring Well W-125 following injection activities and report the results to the Department (Section 4.2, Table II-C).	Within 30 days of receipt of the final laboratory report
The permittee shall submit documentation of well abandonment activities.	Within 60 days of actual well abandonment
The permittee shall submit a report discussing the findings of the pilot test, including all supporting data.	September 30, 2009, or a subsequent date up to the end of this permit, if funding for this project is extended

VI. OTHER REQUIREMENTS FOR ISSUING THIS PERMIT

Technical Capability

APS has demonstrated the technical competence necessary to carry out the terms and conditions of the permit in accordance with A.R.S. § 49-243(N) and A.A.C. R18-9-A202(B). A detailed discussion of technical capability and a list of contractors and qualifications were included in the original application under Attachment 3.

ADEQ requires that appropriate documents be sealed by an Arizona registered geologist or professional engineer. This requirement is a part of an on-going demonstration of technical capability. The permittee is expected to maintain technical capability throughout the life of the facility.

Financial Capability

APS has demonstrated the financial responsibility necessary to carry out the terms and conditions of the permit in accordance with A.R.S. § 49-243(N) and A.A.C. R18-9-A203. The permittee is expected to maintain financial capability throughout the life of the facility. The estimated closure and post-closure costs are $121,275. The financial assurance mechanism was demonstrated through a performance surety bond for $121,275, pursuant to A.A.C. R18-9-A203(C)(2).

Zoning Requirements

APS has been properly zoned for the permitted use and the permittee has complied with all Navajo County zoning ordinances in accordance with A.R.S. § 49-243(O) and A.A.C. R18-9-A201(B)(3).

VII. ADMINISTRATIVE INFORMATION

Public Notice (A.A.C. R18-9-108(A))

The public notice is the vehicle for informing all interested parties and members of the general public of the contents of a draft permit or other significant action with respect to a permit or application. The basic intent of this requirement is to ensure that all interested parties have an opportunity to comment on significant actions of the permitting agency with respect to a permit application or permit. This permit will be public noticed in a local newspaper after a pre-notice review by the applicant and other affected agencies.

Public Comment Period (A.A.C. R18-9-109(A))

The aquifer protection program rules require that permits be public noticed in a newspaper of general circulation within the area affected by the facility or activity and provide a minimum of 30 calendar days for interested parties to respond in writing to ADEQ. After the closing of the public comment period, ADEQ is required to respond to all significant comments at the time a final permit decision is reached or at the same time a final permit is actually issued.

Public Hearing (A.A.C R18-9-109(B))

A public hearing may be requested in writing by any interested party. The request should state the nature of the issues proposed to be raised during the hearing. A public hearing will be held if the Director determines there is a significant amount of interest expressed during the 30-day public comment period, or if significant new issues arise that were not considered during the permitting process.

VIII. ADDITIONAL INFORMATION

Additional information relating to this proposed permit may be obtained from:

Arizona Department of Environmental Quality
Water Quality Division – Groundwater Section – Administration Unit
Attn: Mason Bolitho
1110 W. Washington St., Mail Code: 5415B-3
Phoenix, Arizona 85007
Phone: (602) 771- 4434